Grand Canal
North side of Salt River
Tempe (and Phoenix)
Maricopa County
Arizona

HAER No. AZ-17

HAER
ARIZ,
7- TEMP,
8-

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

Historic American Engineering Record
Western Regional Office
National Park Service
U.S. Department of the Interior
San Francisco, California 94102

HAER
ARIZ,
7-Temp,
8-

HISTORIC AMERICAN ENGINEERING RECORD

Grand Canal

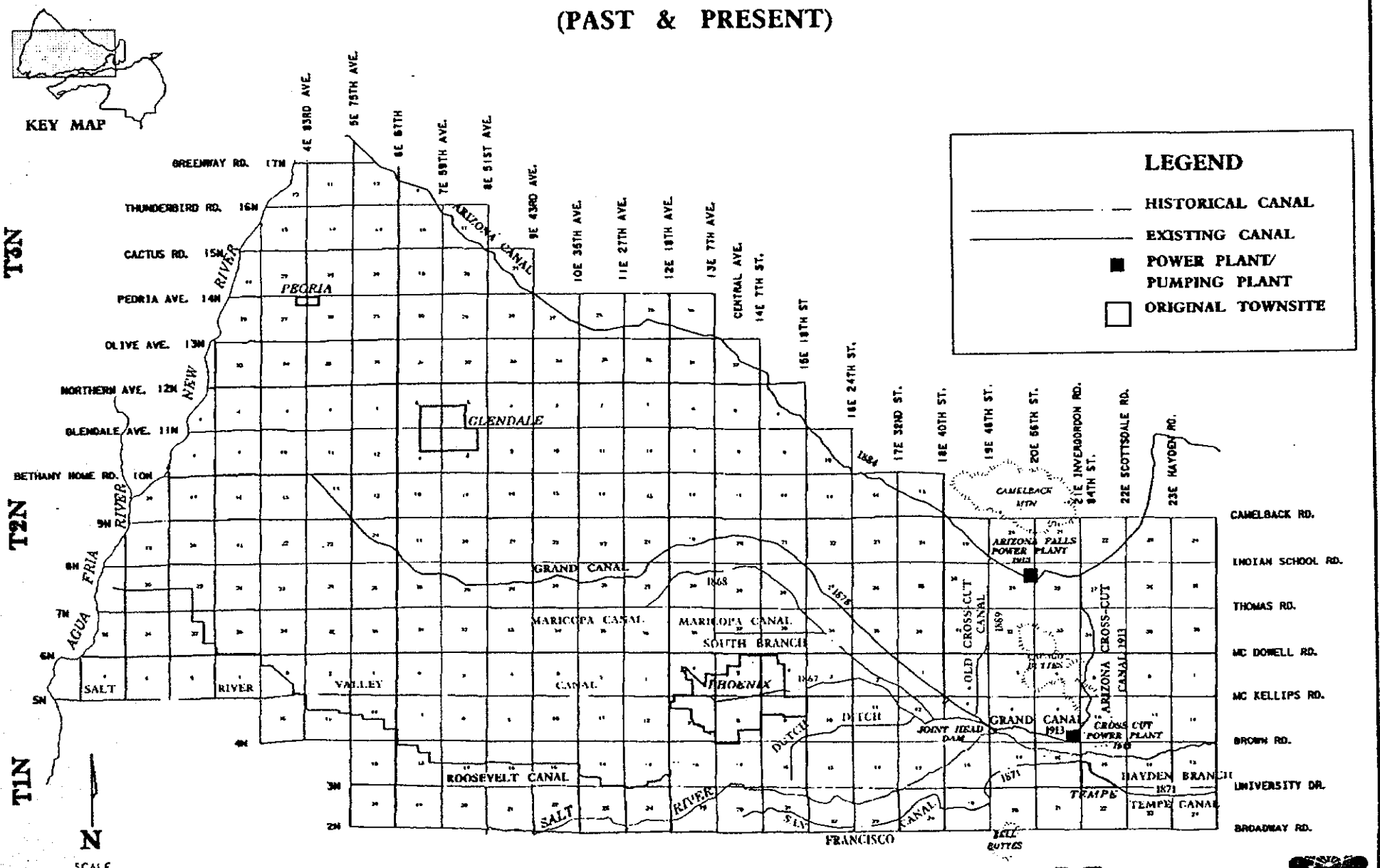
HAER No. AZ-17

Location:	On the north side of the Salt River in the city limits of Tempe and Phoenix, Maricopa, Arizona UTM: Head: 1351853.6/12139665.38 Foot: 1252773.48/12171111.84
Date of Construction:	Original construction - 1878-1879 Widened - 1907-1909 Upper end extended - 1911-1912 Upper end rerouted - 1916 Upper end realigned - 1989
Engineers:	Construction in 1906-1916 supervised by U. S. Reclamation Service, Supervising Engineer: Louis C. Hill
Present Owner:	United States Government; administered by the Salt River Project (SRP)
Present Use:	Conveys water for agricultural, industrial and municipal uses, and for hydropower generation at the Crosscut Hydro Plant.
Significance:	This was the first Salt River Valley canal that was built by a canal company; that improved northside distribution system; that was the site of the most significant low-head hydropower plant of the SRP (Crosscut Hydro Plant).
Historians:	Fred Anderson and Carol Noland Salt River Project Archives

MAP 1

CANALS OF THE SALT RIVER VALLEY: NORTHSIDE

(PAST & PRESENT)



CAR: (140, 13)HISTCANM3.DGN

PE-CAR: (140, 13)HISTCANP.DGN

Grand Canal
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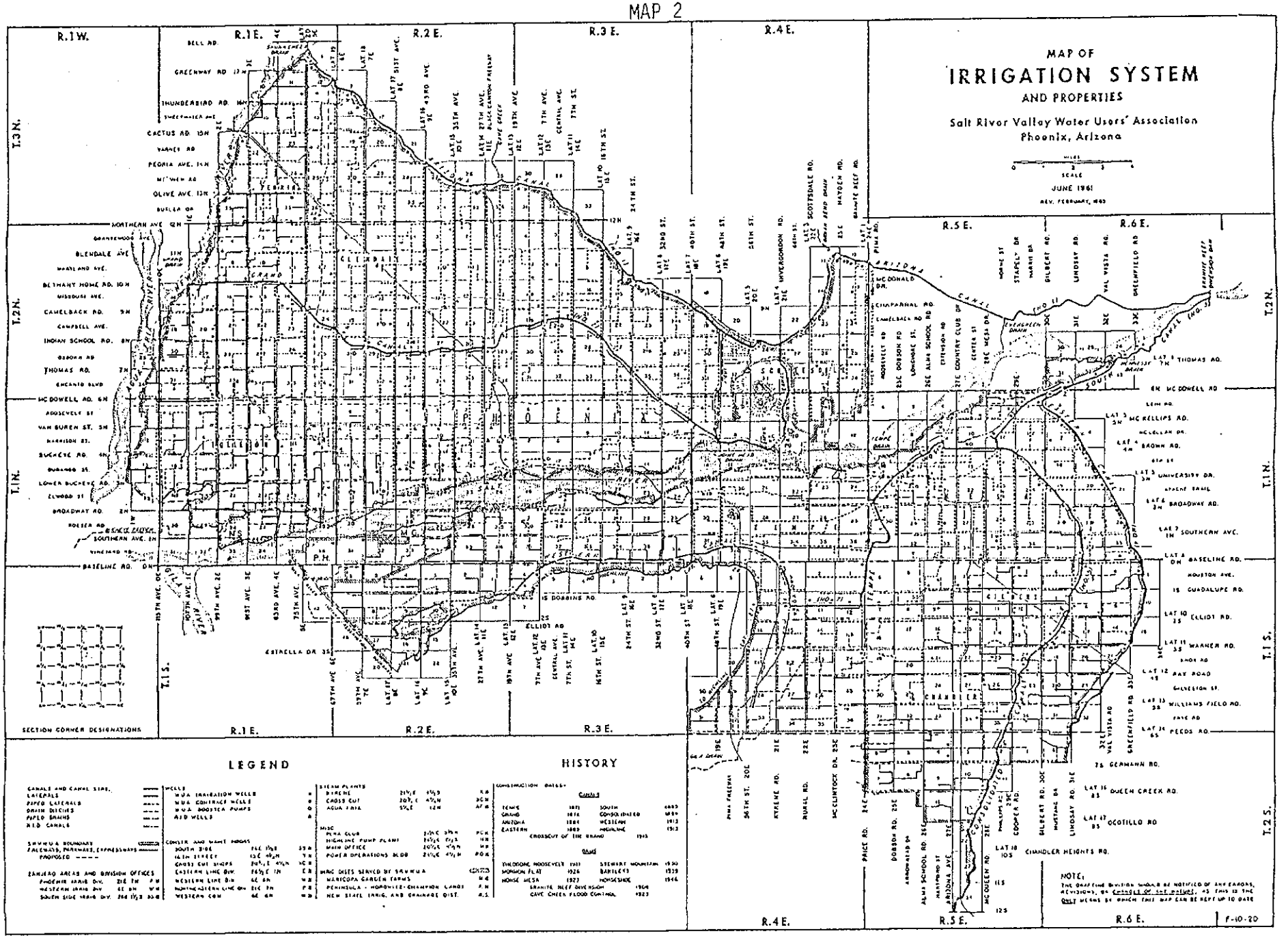
MAP 2



Grand Canal
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The Salt River Valley consists of nearly a half-million acres in central Arizona. It is a semi-arid area with alluvial soils suitable for agriculture, but low rainfall makes irrigation a necessity for farming. Long before the appearance of modern settlers the Hohokam Indians were the primary inhabitants of the Salt River Valley. The Hohokam were farmers who recognized the importance and necessity of irrigation for successful farming. During the 1,700 years of their occupation the Hohokam dug nearly 250 miles of ditches leading out of the Salt River to water their farms. Although the Hohokam left the valley sometime between the 13th and 15th centuries for reasons unknown, evidence of their canal system still remains.

Modern farming and urban development of the valley and the Phoenix metropolitan area were made possible by the damming of the Salt and Verde Rivers by the U.S. Bureau of Reclamation earlier in this century. Today the Salt River Project (SRP) is owned by the federal government and operated by the Salt River Valley Water Users' Association (SRVWUA, a non-profit corporation) and the Salt River Project Agricultural Improvement and Power District (a public power district). The Grand Canal unified the northside irrigation system when it was built in 1878, and is today the oldest northside canal still operating in the irrigation system (see map 1).[1]

Early Irrigation in the Salt River Valley

The impetus for the modern irrigation system in Phoenix was the establishment in 1865 of Camp McDowell at the eastern end of the Salt River Valley. During the Civil War the government sent the few U.S. Army troops stationed in Arizona to join the fighting in the East, leaving the territory open to frequent raids by the Apache Indians. At the close of the war the troops came back to Arizona and set up Camp McDowell in an effort to contain the Apache. The army post not only made settlement in the valley safe for the first time, it also provided an economic reason for farming: the troops needed a local source for hay and grain. Previously, farmers from outside the territory supplied all agricultural products to the troops at great expense. The demand for such products and the seemingly abundant supply of water in the river induced many settlers to attempt farming.[2]

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[1] "SRP Canals," Salt River Project pamphlet, (Salt River Project Archives (hereafter SRPA)), p. 1.

[2] Alfred J. McClatchie, "Utilizing Our Water Supply," (University of Arizona Agricultural Experiment Station Bulletin No. 43, 1902), p. 75.

Like the Hohokam, newly arriving Anglo and Mexican farmers dug ditches and constructed simple dams of brush and rock to irrigate their farms. In 1868 a small group of settlers led by Jack Swilling dug the first permanent canal in the valley. Swilling's Ditch, later called the Town Ditch and the Salt River Valley Canal, came out on the north bank of the river, eight miles southeast of the present site of Phoenix. To handle the management of the canal the farmers formed an association called the Swilling Irrigating Canal Company. In succeeding years many other settlers took out small ditches on both sides of the river.[3]

The farmers who took water from these early canals and ditches established cooperative associations to construct and manage them. The associations levied assessments against the farmers for repair and maintenance of the canals in proportion to the amount of land cultivated by each. Frequently the farmers themselves made any necessary repairs as part of their cooperative agreement.

The Grand Canal

In 1878, a corporation called the Grand Canal Company began digging a canal on the north side of the river. The Grand Canal Company was the first corporation in Arizona organized specifically for the construction and operation of an irrigating system in the Salt River Valley. As stated in the company's articles of incorporation the object of the company was to "carry on and conduct the business of supplying a portion of Salt River Valley . . . with water for agricultural, milling, manufacturing and mechanical purposes, and to this end to purchase, construct, build or dig such canals, dams or flumes as may be necessary . . ."[4] Under this organization water rights did not come from shares of stock, but were represented by a deed from the company to the water users. The company charged the water users an annual fee for water service.[5]

The head of the Grand Canal was about two and one-half miles east of the head of the Swilling Ditch in the northwest quarter of section 15 (T1N, R4E) (see map 1). The company built the canal to supply water to approximately 17,000 acres of new land

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[3]Ibid., p. 77.

[4]"Articles of Incorporation of the Grand Canal Company, dated June 24, 1878," (SRPA).

[5]Joseph H. Kibbey, "Brief on Articles of Incorporation of Salt River Valley Water Users' Association Dated May 25, 1903," (SRPA), p. 34.

north of Phoenix. By 1878 claims to the Salt River exceeded five and one-half times its average yearly flow and people did not respond favorably to the Grand Canal Company's claim to divert 10,000 miner's inches of water. Many feared that there would be no water left in the river after the Grand Canal took its claim. Reacting to this threat to the water supply, "a mob tore out the dam of the Grand Canal just after its construction." The company rebuilt the dam, and the Grand Canal is today the oldest canal still in use north of the Salt River.[6]

In an attempt to remedy the water problem north of the river, the stockholders of the Grand Canal Co. appointed a committee on August 30, 1879, to meet with the directors and owners of the canals on the north side about the possibility of supplying all of the canals through a single head. The Farmers' Canal Co., Griffen Ditch Co. and Monterey Ditch Co., responded to the proposal with a lawsuit, each asserting a priority to the water ahead of the Grand Canal. The plaintiffs also named the Mesa Canal Co. as a co-defendant. The court agreed with the priority claim but it refused to issue an order to stop the defendants from taking water. The court based its decision on the grounds that the water the defendants took out of the river would not make any difference in the amount available to the plaintiffs.[7]

In February 1881, Territorial Assemblyman Peter J. Bolan made the first attempt at a legislative solution to the water question. Bolan introduced a bill to establish each canal's priority to water and the amount each could take from the river. The measure appeared to have support in Phoenix, but Tempe Canal users opposed it, and the Legislative Assembly overwhelmingly defeated it.[8]

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[6]Earl Zarbin, "Phoenix: The Reservoir Chase before June 17, 1902," (manuscript, n.d., SRPA), p. 5; Phoenix Herald, April 11, 1888; January 15, 1892; Salt River Herald, July 6, 1878; August 17, 1878. A miner's inch is a unit of measure equivalent to 1/40 cubic feet per second or 11.22 gallons per minute of flowing water.

[7]Farmers Canal Company et al v. Grand Canal Company et al, (No. 88, Second District Court, Maricopa County, Arizona Territory, 1880).

[8]Zarbin, "Phoenix: The Reservoir Chase before June 17, 1902," p. 6; Expositor, February 25, 1881; March 11, 1881; Arizona Gazette, March 7, 1881.

The Kibbey Decree

In 1883 the Arizona Canal Company constructed a canal with a dam above all other canals in the valley, and claimed a right to divert a quantity of water greater than the normal flow of the river. The other canal operators naturally considered this new organization a threat and on February 7, 1887, they filed suit against the Arizona Canal Company to enjoin it from diverting the water claimed by the plaintiffs. After the plaintiffs filed the suit the Arizona Improvement Company, which had acquired the Arizona Canal, secured a controlling interest in the Grand Canal Company, the Maricopa Canal Company, and the Salt River Valley Canal Company, effectively controlling the north side of the river, and withdrew them from the suit as plaintiffs. Later, all of the canal companies on the south side of the river, except the Tempe Irrigating Canal Company and Michael Wormser, the operator of the San Francisco Canal, withdrew from the suit.[9]

By the time the trial began in March 1890, the Tempe Canal Company and Michael Wormser had named all of the other canal companies in the valley as defendants. The case is therefore known as M. Wormser et al v. Salt River Valley Canal Company et al. Judge Joseph Kibbey in the Third Judicial District Court, Maricopa County heard the case. Judge Kibbey rendered his decision in April 1892, and made the accompanying decree in October 1892.

This was the first important water rights case in Arizona, as it established most of the critical principles of the state's water law. First, Judge Kibbey held that only owners and occupants of land were entitled to appropriate water, and a right could only be established by appropriation and use of water on the land. Second, he upheld the custom of priority of rights based on date of appropriation and continuous use. Third, he held that the posting and recording of a notice of intention to divert water did not give any right to water, but the actual diverting and applying it to land did. Fourth, he decided that canal companies were common carriers of water and could not themselves own water or water rights, and that the sale of water was not a use of it. Fifth, Kibbey held that the right of appropriation of water was permanently appurtenant to the land which it irrigated, and that the ownership of stock in a canal without ownership of land to irrigate did not in itself amount to a water right.[10]

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[9]Alfred J. McClatchie, "Utilizing Our Water Supply," p. 83.

[10]"Decision," M. Wormser et al v. Salt River Valley Canal Company et al, (No. 708, Second Judicial District, Maricopa County, Territory of Arizona, 1892).

Despite the importance of the legal principles established, the Kibbey Decree had only one immediate effect on water distribution in the valley, which was to assure the water supply of the Tempe and the San Francisco canals against all the other canals. Since the defendant companies had joined in a contract to share and divide all the water not required by the Tempe and San Francisco, even before Kibbey made his decree, the only function of the court appointed water commissioner was to designate the supply for those two canals.

The Northside System

In 1889 the Arizona Improvement Company created the Crosscut Canal and Power Company to construct a canal connecting the Arizona Canal with the Grand Canal and the Joint Head canal, which served the Maricopa and the Salt River Valley canals. The Crosscut would supply all of the northside canals with water from the Arizona, thereby creating a unified northside system. Since the Arizona carried water to the Grand Canal through the Crosscut, the original head of the Grand was abandoned. In 1898 the Arizona Water Company, headquartered in New York City, secured the majority interest in the Arizona Improvement Company and solely controlled the distribution of water to all the lands on the north side of the Salt River.[11]

When Theodore Roosevelt signed the Reclamation Act of June 17, 1902 the farmers of the Salt River Valley formed a Water Storage Committee to submit a plan to the U.S. Department of the Interior for building a reservoir on the Salt River, about sixty-five miles northeast of Phoenix, at a site called the Tonto Basin. A prolonged drought during the 1890s had shown the farmers that dependence on the natural flow of the Salt was risky, and that the best solution was a storage dam on the upper Salt. Under the Act, the U.S. Reclamation Service (USRS) would build and finance selected irrigation projects. The committee was hopeful that the Tonto site would be among the first projects built under the Act, since U.S. Geological Survey engineer Arthur P. Davis had already described the Tonto project as one of the most ideally situated in the West in terms of the storage capacity of the reservoir, the fertility of the irrigable land and the climate of the area.[12]

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[11]United States Reclamation Service, "Salt River Project Arizona, Final History to 1916 vol. II," (manuscript, 1916, SRPA), p. 288.

[12]Arthur P. Davis, "Irrigation Near Phoenix, Arizona," U.S. Geological Survey Water Supply Paper No. 2 (Washington: Government Printing Office, 1897).

On August 9, 1902 George Maxwell, executive director of the National Irrigation Association, addressed a meeting of the farmers of the valley. He emphasized the importance of the farmers owning the canal system. He told them that the government would not build the Tonto dam if it was being constructed for "the eventual benefit of . . . shareholders in a canal company instead of the owners of the land which would be irrigated by the system." He proposed that the farmers organize a single company to buy the canals so that they would have "a common distributing company as the agent of each and all . . . land owners to receive the water from the government and distribute it . . ."[13]

In order to buy the northside system the farmers would have to deal with the Arizona Water Company. Maxwell had already met with Arthur Leach, president of the Arizona Water Co., and told him "that it was absolutely useless to undertake to get the government to build the reservoir and put any of the water on the lands under the Arizona Canal unless the Arizona Canal was willing to fix a valuation upon its property which the land owners under the canal would accept." While Leach made no immediate response to Maxwell's suggestion, a few days later, William H. Cleary, general manager of the water company, reported that he did not foresee any problems in arranging for the water users to acquire the northside canals, although he did not say how it could be done.[14]

On October 2, 1902 the Water Storage Committee proposed a plan for the formation of an association of all landowners, based on land ownership, thus preventing the canal companies from participating. Any landowner wanting water rights would have to join the association, which would have a central governing board to deal with the government, and to control all matters of common interest. However, the central board would not control the separate canal systems. Individual landowners would supervise the management of the canals and the distribution of water. The amount of water each landowner would receive would be determined in proportion to his acreage of land.[15]

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[13]Earl Zarbin, "Buying the North Side Canals," (manuscript, n.d., SRPA), p. 2; Arizona Gazette, August 10, 1902; Arizona Republican, August 10, 1902.

[14]Arizona Gazette, August 10, 1902; Arizona Republican, August 17, 1902.

[15]Karen L. Smith, The Magnificent Experiment: Building the Salt River Reclamation Project, 1890-1917, (Tucson: The University of Arizona Press, 1986), p. 30.

While this plan did not address every concern about a merger association, it was a start. The Water Storage Committee named Judge Joseph Kibbey and George Maxwell to write the articles of incorporation for the Salt River Valley Water Users' Association.[16] These articles would represent the interests of all the farmers, guarantee repayment for the dam, and provide for the operation of the completed irrigation system. The draft articles were presented to the Water Storage Committee in January 1903. Although some of the members of the older canal companies expressed concern that their investment in land improvements and their superior water rights would be diluted, the committee passed the articles on on January 21, 1903, just as Kibbey and Maxwell had written them.[17] The public showed their acceptance of the articles by the number of them that signed up their lands to the new association, although several of the dissenting canal companies on the south side of the river voted not to join the Association. The Salt River Valley Water Users' Association incorporated under Arizona law on February 9, 1903.[18]

Soon after incorporation the Association turned its attention to restructuring the canals into one system. At that time, however, the Arizona Water Company still controlled water distribution on the north side. Initially the cost of buying the water company's interests was too high for the Association to seriously consider purchasing them. But after a flood in 1905 destroyed a large portion of the Arizona Dam and canal, the water company, not wanting to bear the cost of repairs, was more willing to negotiate. Unable to agree upon a fair price, the Association and the Arizona Water Company agreed to let a government-appointed commission appraise the value of the water company's holdings.[19]

Secretary of the Interior Ethan A. Hitchcock approved the request for a commission and appointed George Wisner, W.H. Sanders and A.E. Chandler on June 14, 1905. In the meantime, the

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[16]The organization was known as the Salt River Valley Water Users Association (SRVWUA); the dam, canals and allied features, known as the Salt River Project were operated by the U.S. Reclamation Service (USRS) until 1917, when the SRVWUA took over operating responsibility. Title to the system remains in the U.S.

[17]Minority Report, Salt River Valley Water Storage Committee, and Amendments Offered by the Minority of Salt River Valley Storage Conference Committee in Support of Their Report, January 17, 1903 (SRPA).

[18]Smith, The Magnificent Experiment, p. 38-39.

[19]Ibid., p. 58-59.

Association and the water company prepared a contract providing for either the Association or the government, subject to Hitchcock's approval, to purchase the water company. The Association would levy assessments on the water users to pay the company directly or to repay the government for the purchase. Upon reviewing the contract Secretary Hitchcock decided that "the interests of the government will be best subserved . . . by the purchase of the property of the Arizona Water Company directly by the United States . . ." After many months of negotiation, on March 7, 1906, Hitchcock approved the contract for purchase of the northside canal system.[20]

On June 15, 1906 the United States purchased the Grand Canal for a price of $25,731.34. This price included "all headgates and lateral ditches, including the North extension of said canal, also including its banks, bed, right of way, extensions, enlargements and addition thereof, as the same is now constructed, used and operated by the said The Grand Canal Company . . . Also the one third interest owned by the said Grand Canal Company in the canal and water way known as the Water Power Canal (Crosscut)."[21]

The Appropriators Canal

The Reclamation Service commenced the operation of the north side canals on May 15, 1907, but at that time the Appropriators' Canal, which paralleled the Grand Canal (see photo AZ-17-34), delivered water to lands that the Grand Canal had previously irrigated.

From 1897 to 1904 a virtually continuous drought plagued the Salt River Valley. Many farmers, dependent on the river to irrigate their crops, thought that relief had finally come when, on July 21, 1904, after nine months without rain, more than one half an inch fell on the valley. Although the Arizona Canal filled with water and water two feet deep plunged over the Arizona Canal Dam, many farmers north of the river could not get any water because the canals were filled with silt, sand, brush and weeds. The farmers blamed the Arizona Water Company for the condition of the canals, but the Water Company did not respond to their complaints.[22]

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[20]Zarbin, "Buying The North Side Canals," p. 15.

[21]Quit Claim Deed, Grand Canal, June 15, 1906, (SRPA).

[22]Earl Zarbin, "The Appropriators' Canal," (manuscript, n.d., SRPA), p. 2; Arizona Republican, July 22, 1904; July 24, 1904; July 25, 1904; July 26, 1904.

The farmers then took matters into their own hands. On July 30, 1904 Lincoln Fowler and Patrick Hurley formed their own canal company to dig a canal parallel to the Grand using the former head of the Grand Canal in the Salt River. Their intent was to divert flood water that came over the Arizona Dam as an additional source of water for users on the north side. The head of the Grand, located one and a half miles north of the Tempe Buttes, had not been used since the opening of the Crosscut Canal in 1889. Fowler, Hurley, John P. Orme, Henry Wilky and Thomas Armstrong Jr. incorporated the Appropriators' Canal Company on August 6, 1904 with a capital stock of $50,000.

It took from August, 1904 until January, 1905 for workers to complete the six miles from the canal head to a point a quarter mile east of the intersection of the Grand and Crosscut canals. They could not cross this last quarter mile to the intersection because the Arizona Water Company owned the property. Good luck fell on the Appropriators', however, when bad luck hit the Arizona Canal. After flood waters partially destroyed the Arizona Dam in April, 1905, the Appropriators' became the main source of water for all the land under the Grand, Maricopa and Salt River Valley canals. While the Salt River Valley and Maricopa canals could still get some water from the Joint Head Dam, the best opportunity for the Grand Canal was to make an arrangement with the Appropriators'.[23]

In late April Lloyd B. Christy of the Grand Canal Company approached the Appropriators' with a plan to connect the two canals. Christy wanted the Appropriators' to repair and lease the Grand Canal from its headgate to the intersection with the Crosscut Canal while the Grand would pay for water delivered at the Crosscut until it could get water from the Arizona again. The Appropriators' returned with two plans of its own. The first called for the Appropriators' to finish the canal at its own expense provided the Grand would obtain the Arizona Water Company's permission to cross the last quarter mile. The second plan called for the Grand Canal Company to finish the work at the Appropriators' expense. In return, the Grand Canal Company would agree to obtain water from the Appropriators' until the Grand could get water from another source.[24]

When the Grand Canal Company and the Appropriators' Canal Company could not reach an agreement, the Appropriators' stockholders, feeling they had no other choice, decided to link the canals anyway. The farmers on the north side needed water while the Arizona Water Company repaired the dam. This decision meant that the Appropriators' would have to dig a canal parallel

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[23] Arizona Republican, April 23, 1905.

[24] Arizona Republican, April 27, 1905.

to the Grand since the Grand Canal Company was not cooperating in the effort. On May 1, 1905 a party of men began extending the head of the canal a half mile east into the river bed. They made the drop from the river bottom to the canal high enough that building a dam would not be necessary. A second party of men worked to connect the Appropriators' to the Grand Canal. They accomplished this by digging under the Crosscut and constructing a flume, twenty feet wide and three feet deep to carry the Crosscut. The Appropriators' Canal then continued a short distance westward where it joined the Grand Canal. On May 30 workers turned water into the Grand Canal and began work on the parallel canal which was to cross the property that belonged to the Arizona Water Company.[25]

On June 9, the Arizona Water Company obtained an injunction ordering the Appropriators' to cease the delivery of water through the Grand Canal and the construction across the Company's property. The Appropriators' continued to deliver the water arguing that the farmers had an extraordinary need for it. They also brought their own suit to condemn the Arizona Water Company's land for use as a canal. On June 14, Judge Edward Kent dissolved the injunction, and ruled that the Appropriators' could construct the canal but had to pay the water company for the right-of-way.[26]

To continue the canal the workers needed to go through an eighty-acre parcel of land reserved as part of the Phoenix Indian School, about three and one half miles from Phoenix. On July 12, 1905, Lincoln Fowler wrote to C.M. Goodman, Superintendent of the U.S. Indian School, requesting that the Appropriators' be given a right-of-way across the southeast quarter of Section 21, T2N, R3E to construct its canal line. For this right-of-way Fowler proposed "to give the capital stock of the Appropriators' Canal Company, at par value, $1.00 per share, in exchange for land occupied at $40.00 per acre. We will also ask that your institution take stock for the remainder of your land which lies below our line of service, and approximates 170 acres."[27]

Superintendent Goodman then wrote to the Commissioner of Indian Affairs recommending the request be granted. Goodman pointed out that after the Arizona dam broke, the Appropriators' built part of the canal "by which means the settlers under the Grand canal (including the Indian School) were enabled to obtain

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[25] Arizona Republican, April 30, 1905; June 8, 1905.

[26] Arizona Republican, June 10, 1905; June 15, 1905.

[27] Lincoln Fowler, President Appropriators Canal Company to C.M. Goodman, Superintendent U.S. Indian School, Phoenix, Arizona, July 12, 1905 (SRPA).

water some weeks in advance of the repairing of the Arizona dam. The Indian School assisted in this work . . . and has doubtless already been benefitted to the amount of the capital stock subscription desired." On August 26 the government granted the right-of-way and became a shareholder in the company.[28]

Despite the Appropriators' success in supplying water to the north side farmers, the company ran into financial problems. A flood in November, 1905 submerged the canal head and three miles of the waterway. Further west the river broke through the southern bank of the canal requiring the construction of an artificial side. Additional floods in March, 1906 and January, 1907, brought even more damage. The high cost of repairs increased the company's debt and led to talk of selling to the government. On March 23, 1907 shareholders elected John Orme, Dwight Heard and Patrick Hurley to a committee to sell the canal to the federal government as soon as possible at a price to be determined by government engineers. The committee met with Louis Hill of the Reclamation Service but the negotiation process was slow. Although the committee wanted the government to set the price for the canal, they wanted to receive at least enough money to cover their mortgage of $30,000. The government, however, did not consider the canal worth that much to the overall water distribution system, since it already owned the Grand Canal. The fact that the canal company could not show clear title to their right-of-way also concerned the government.[29]

On June 30, 1908 the Appropriators and the Reclamation Service reached an agreement whereby the Reclamation Service would supervise and direct the distribution of water while the Appropriators' paid all expenses. The Appropriators' continued to reduce its debt and before the end of 1908 had settled with all its creditors. On January 19, 1909 the Appropriators' transferred title to the canal to the government and filed a quit claim deed with the Maricopa County Recorder. According to the quit claim deed the government paid one dollar for the property, although it is not known if the government made any other monetary compensation. The government used portions of the Appropriators in the enlargement of the Grand Canal, but abandoned the majority of it.[30]

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[28]C.M. Goodman, Superintendent U.S. Indian School to Francis E. Leupp, Commissioner of Indian Affairs, July 22, 1905 (SRPA).

[29]L.E. Fortier, "Early Irrigation Systems in the Salt River Valley," (unpublished paper, 1971, SRPA), p. 15-16.

[30]Salt River Project, Final History to 1916 vol. II, p. 303-304.

Grand Canal Enlargement and Extension

The government began work on the reconstruction and enlargement of the Grand Canal in November, 1907, at Park Road (16th Street in Phoenix), and ended at New River, a distance of fifteen miles, in June, 1909. According to a report from the constructing engineer to the project engineer dated May 27, 1912, "during this time, nine drops, two checks, fourteen siphons, eighteen turnouts, three concrete arch bridges, fourteen truss bridges, two stringer bridges, eighty-two lateral structures, and about thirty-two and a half miles of laterals were built" (see photos AZ-17-2 and AZ-17-4 for examples of above structures). Despite the extensiveness of the project, workers interrupted water service as little as possible, which made the project more expensive than if it were dry excavation.[31]

During the two years of enlargement several mishaps occurred. At the site of a newly constructed lateral[32] farmers caused problems when they flooded the excavation. The top of a siphon one-half mile west of Alhambra failed and once workers repaired it, floods washed out the canal bank around the intake of the siphon three times. The constructing engineer blamed the washouts on "farmers who objected to having water delivered to their lands from the Arizona Canal." Due to floods from Cave Creek engineers had to set the structure at the head of the Salt Lateral three times. Waste water from the Alkire Ranch caused additional problems at this site. At a place known then as Green's Corner, light soil caused difficulty with the paved walls at the end of the turnout. In the Arizona Lateral, running north from the Salt Lateral, one structure had to be lowered one foot after its completion, and the forms of two others reset, having been originally set too high.[33]

Between the months of February and September, 1911, project workers constructed Lateral 16 of the Grand Canal, located at 43rd avenue, to serve approximately 9,000 acres of land. This work comprised seven miles of main lateral, seventeen miles of sub-laterals, three pipe siphons, thirty-five wooden bridges (see photo AZ-17-5), ten concrete road crossings, containing 528 cubic yards of concrete. The material was mostly all compact earth. The equipment used included two and four-horse Fresno scrapers and slip scrapers. During the project workers used 3,526 sacks of cement, 79,970 feet of lumber and 18,781 pounds of iron.

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[31]Constructing Engineer to Project Engineer, Phoenix, May 27, 1912 (SRPA).

[32]A lateral is the secondary ditch which conveys water from the main canal to the sublateral or farm ditch.

[33]Ibid.

Builders completed most of the work by July 1 but heavy rains and extremely hot weather caused delays and damage which prevented the completion of the project until the end of August. Total cost for the project amounted to $46,149.97, $11,117.82 over the original estimate.[34]

In 1910 the Association reached an agreement with the Interior Department to extend and enlarge the Grand Canal two miles east as part of the Association's plan to increase hydropower production. Under the contract of August 30, 1910 the Association would finance the construction of a hydro generating plant (see HAER No. AZ-30 on Crosscut Hydro plant) at the fall between the new Crosscut canal and the Grand extension through a special assessment levied on its members and would use contractors for all work.

On November 28, 1911, the Salt River Valley Water Users' Association asked for bids for the enlargement of the Grand Canal from the old Arizona Canal Crosscut to Park Road, a distance of five miles. The Association split the work into three divisions: Division 1 covered 50,000 cubic yards, Division 2 comprised 35,000 cubic yards, and Division 3 covered 40,000 cubic yards. The Association accepted two bids, each for one division only. The Grant Brothers Construction Company of Los Angeles bid only on Division 1 for eighteen cents per cubic yard. J.C. Norton of Phoenix bid on all three divisions but only his bid on Division 3, at a cost of twenty-six cents per cubic yard met with approval. The parties accepted each contract with the understanding that if there was time they would work on Division 2, connecting the old Grand and Appropriators canals.[35]

The Grant Brothers began work on December 15, 1911 and completed their section, including all lateral connections and header laterals necessary for water distribution, on February 1, 1912. J.C. Norton began work on January 1 and completed his division and the connection with the Grand and Appropriators canals, and about 1800 feet of canal on Division 2 by February 1, 1912.[36]

Throughout the enlargement the contractors built all laterals and fences with the exception of a private lateral built

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[34]Salt River Project, Arizona, "History of the Project for the Calendar Year 1911," (hereafter SRP Annual History),(SRPA), p. 11-12.

[35]Assistant Engineer F.D. Angel to Project Engineer, Phoenix, Arizona, May 27, 1912 (SRPA).

[36]Ibid.

by a Mr. Osborne in the northwest quarter of Section One, (T1N, R3E). Since this lateral was to go through Mr. Osborne's yard where there were trees he wanted to protect and there was also a newly constructed fence, the Reclamation Service wanted to be relieved of any liability in going onto and damaging this property. The Association offered Mr. Osborne eighty-five dollars, the average cost of building a lateral[37] to do the work himself, which he did to his own satisfaction. The Norton contract was for $15,970.46, and the Grant Brothers contract amounted to $11,941.78.[38] The total cost of the enlargement work amounted to $27,012.24.

On June 30, 1911 the Association called for bids for the extension of the Grand Canal from the old Arizona Cross Cut to the Crosscut site a short distance west of the Tempe Railroad bridge over the Salt River. This contract was for the excavation of 150,000 cubic yards of earth, loose rock and solid rock. The Grant Brothers Construction Company were low bidders for the excavation work, with prices of fifteen cents per cubic yard for Class 1 material (earth), forty-five cents per cubic yard for Class 2 (loose rock), and one dollar and ten cents per cubic yard for Class 3 (solid rock). The contractors estimated the quantities of material to be 102,198 cubic yards of Class 1, 5,125 cubic yards of Class 2, and 40,277 cubic yards of Class 3. Grant Brothers began work on October 1, 1911 and worked continuously until January 1, 1912. They then put their work force on Division 1 of the Grand Canal enlargement until that contract was finished on February 1, and then returned to the extension. They had removed all but about 200 cubic yards of material when heavy rains made it necessary for them to leave the work until the concrete contractor finished the siphon.[39]

The Association granted the concrete contract for the extension to Shumway & Bowen of Mesa, Arizona. The contract included a reinforced concrete girder wagon bridge across the Grand Canal at the Tempe Road crossing, waste-gate structures into the Salt River (see photos AZ-17-24 and AZ-17-36), two siphons under the Phoenix and Eastern and Maricopa railroad tracks (see photo AZ-17-35), and two small lateral siphons under the Grand Canal. In April, 1912 the contractors began excavation for Siphon No. 1, which involved cutting through the existing railroad bed to a depth of twenty-seven and one-half feet, and a width of twenty-four feet. Per a contract between the Arizona Eastern Railroad Company and the Water Users' Association, the

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[37] Ibid.

[38] SRP Annual History 1912-1913, p. 18.

[39] Assistant Engineer to Project Engineer, Phoenix, Arizona, May 27, 1912 (SRPA).

railroad company provided a foreman to take care of the track and build necessary trestles and bulkheads to protect and insure the safe passage of trains. Arizona Eastern also had final approval of all operations that crossed their tracks. Workers completed the siphon on June 15, 1912,[40] ending all work on the canal enlargement and extension.

Grand Canal Reconstruction

From January 19th to the 27th, 1916 a severe flood on the Salt River caused by floods on the Verde and an overflow at the Roosevelt Reservoir, did considerable damage to the Grand Canal. The flood washed out a portion of the canal extension from the Crosscut power plant to the Joint Head dam, a distance of about one mile, which had to be entirely reconstructed (see photo AZ-17-33 for a map of the damage and repair). Flood waters broke into the old, unused portion of the canal at point "E", spilling over and eroding a cross bank at point "A" which had separated the upper section of the old canal from the new canal.[41] In order to prevent damage farther down the canal, the zanjero cut the outer bank at point "B", about 3600 feet down-stream from point "A". This caused erosion at point "C" which cut the outer bank and allowed more water to flow in from the river. Through a break which occurred at point "D" a small amount of water flowed back toward the river.[42]

When the water receded government builders relocated the canal farther North of the river and gave it a straighter alignment. They also built a cross dam in the old canal at point "H" to prevent future floods from entering the old canal at point "C". Also, workers constructed a dike across the dam at point "A" to raise it six feet. Contractors used loam mixed with sand and gravel, considered the best material, to build the dike and built it on a sand and gravel foundation. To further protect the dike they anchored woven wire fences piled with brush to the embankment. Workers also planted willow trees on the river side, which, while not providing any immediate protection, would be useful after a year or two of growth.[43]

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[40]Assistant Engineer to Project Engineer, Phoenix, Arizona, June 26, 1912 (SRPA).

[41]Zanjero is a Spanish word meaning one who is associated with ditches. It is commonly used in the Southwest to mean the person responsible for the delivery of irrigation water from a canal system to the user.

[42]SRP Annual History 1916, p. 43-45.

[43]Ibid., p. 45-48.

This project, completed in May, 1916, required from 200 to 250 head of stock and an average of 200 men earning two dollars and twenty-five cents per day. These workers moved 23,770 cubic yards of solid rock, 91,800 cubic yards of earth and used 9,250 pounds of dynamite and 3,200 pounds of black powder for rock excavating. The total expense for this project was $58,936.62.[44]

Civilian Conservation Corp (C.C.C.) work

In the fall of 1935 the government assigned two Civilian Conservation Corps (C.C.C.) camps, with about 200 men each, to assist the Salt River Project. Work programs for the C.C.C. workers consisted mostly of constructing buildings, making and laying concrete pipe, lining canals and laterals, building structures in canals and laterals, and clearing and grading roads along canals and power lines (see photos AZ-17-11 and AZ-17-12).[45]

One of the largest projects of the C.C.C. was the construction of a forebay (regulating storage basin) on the Grand Canal at Lateral 23. Lateral 23 was a low delivery point on the canal and received waste water from areas west of Phoenix, north of the canal. Due to this influx of waste water and also to unavoidable "operation losses and gains" the flow of water was subject to fluctuations at this point. These fluctuations made it impossible to accurately forecast the quantity of water available at the head of the lateral.

To correct this problem workers enlarged a section of the canal extending west a half-mile from Lateral 23. The enlargement was on the north side and required the purchase of a new right-of-way. The forebay held a capacity of approximately twenty-one acre feet and was successful in regulating the fluctuations without wasting water. C.C.C. workers also deepened and widened Lateral 23 at the head so that they could install a float-controlled eight foot radial gate, capable of regulating the water level to within a half-inch. Work began on this job on July 15, 1936 and ended February 1, 1937.[46]

Another project involving C.C.C. workers was the elimination of the Maricopa Canal in 1937. The Maricopa, built in 1872, had a very low velocity due to its flat slope which led to a build-up of silt deposits and made it very expensive to maintain. Since the Grand Canal paralleled the Maricopa less than a mile to the

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[44]Ibid., p. 50-52.

[45]SRP Annual History 1935, p. 3-5.

[46]SRP Annual History 1937, p. 5.

north the SRP decided the Maricopa was unnecessary. C.C.C. forces had the task of enlarging some of the outlets on the Grand and increasing the capacity of the Grand laterals running south to connect with the laterals of the Maricopa. Workers began the project on March 11, 1937 and completed it on July 20.[47]

The government discontinued the C.C.C. work on March 31, 1938 due to complaints by labor unions charging that C.C.C. workers were doing the skilled work of union members. In the two and a half years that the C.C.C. forces operated they completed over 700 different jobs.[48]

Rehabilitation and Betterment (R&B) Program

Due to the economic depression of the 1920s and 1930s and the outbreak of World War II many reclamation projects in the West suffered from neglect. The lack of finances and manpower meant that regular maintenance on project structures was not possible. The deteriorated condition of many projects led to a substantial decrease in the efficiency of water distribution. By the end of the 1940s, the Federal government recognized the poor state of the early reclamation projects and undertook to repair them. In 1949 Congress passed legislation authorizing the Bureau of Reclamation to fund rehabilitation and betterment (R&B) work on older reclamation projects, including the Salt River Project. Work done at Salt River included replacing lateral gates made of aged redwood with gates made of concrete and metal, repairing and replacing siphons, bridges, and other structures used for water transmission and distribution, and lining canals and laterals which had experienced weed growth and seepage problems.[49]

Work on the Grand Canal consisted mainly of lining areas where erosion and scouring had occurred, particularly below canal structures. Workers generally lined canals with concrete or sprayed gunite, a mixture of sand, cement, and water (also called pneumatically applied mortar). Before the gunite could be applied, workers reshaped and formed the canal by excavating accumulated sand and debris from the bottom of the canal and placing compacted gravel along the sides for reinforcement. To

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[47]Ibid., p. 4.

[48]SRP Annual History 1938, p. 8.

[49]Jay C. Ziemann, "The Modernization of the Salt River Project: The Impact of the Rehabilitation and Betterment Program," (M.A. thesis, Arizona State University, 1987), p. 45-46.

add structural reinforcement, they placed steel mesh along the sides and bottom.[50]

The first major lining job of the R&B Program on the Grand Canal was from Lateral 18 to Lateral 20. In 1951 workers lined approximately two and one-half miles (611,970 square feet) of the canal with one and a quarter inch thick gunite on the sides and bottom. The approximate total cost for this portion of the lining was $170,000, which included reshaping ditches and removing trees. In some portions of the canal horses were used due to the swamp like conditions which prevented the use of heavy equipment in the bottom.[51]

During 1959 workers placed approximately 1,350 square feet of gunite and 3,900 square feet of unreinforced concrete lining in the Grand Canal. This increased the amount lined in the Grand to 633,233 square feet, almost three square miles. By 1969 workers had lined 715,876 square feet of the canal.[52]

Another priority of the Rehabilitation and Betterment program was the replacement of obsolete gates and structures. At the end of the program workers had replaced several thousand wooden lateral gates with metal gates, termed standard steel screw stem gates. These gates were fabricated on a mass-production basis, sand-blasted and sprayed with a protective zinc coating by the Project's machine shop. The most significant feature of these gates was the water-tight rubber seal which became a very popular design both in the United States and abroad. Workers replaced five of the redwood turnout gates on the Grand Canal with new metal gates (see photos AZ-17-10 and AZ-17-17), and constructed two radial gate structures at Laterals 21 and 22.[53]

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[50]Ibid.

[51]Resident Engineer to Regional Director, Boulder City, Nevada, August 2, 1951; Area Engineer to Chief Engineer, Denver, Colorado, November 13, 1951 (both SRPA).

[52]Acting Area Engineer to Regional Director, Boulder City, Nevada, September 1, 1959; Assistant Regional Director, Phoenix, Arizona to Regional Director, Boulder City, Nevada, October 14, 1969 (both SRPA).

[53]"Data for Narration of Construction Movie," SRP Records Management Box 206-80; Resident Engineer to Regional Director, August 2, 1951; Acting Area Engineer to Regional Director, September 1, 1959 (all SRPA).

East Papago Freeway Realignment

On January 15, 1987 SRP officials broke ground on its corporate complex in the Papago Park Center (PPC). The complex was designed to house SRP's complete corporate headquarters. In addition 440 acres of SRP-owned land would be available to private developers. As part of the PPC development SRP made an agreement with the Arizona Department of Transportation (ADOT) for the extension of the East Papago Freeway paralleling the Salt River bed. In this agreement ADOT received right of way to construct the freeway on SRP land, and in exchange, would narrow the width of the Salt River through the southern portion of PPC land[54] which would provide additional developable acreage for PPC.

The extension of the freeway required the realignment of Washington Street and the Southern Pacific railroad which, in turn required the realignment of a portion of the Grand Canal. The canal had to be relocated south of the proposed Washington Street crossing and north of the proposed railroad realignment (see map 3). During the summer of 1989 workers realigned approximately 1600 linear feet of the canal east of Priest Drive in the southeast quarter of section nine (T1N, R4E) (see photos AZ-17-18 - AZ-17-23). Further west near 32nd Street construction on the freeway required realignment of another portion of the canal in the northwest quarter of section one (T1N, R3E).

Despite the many changes the Grand Canal has undergone since its construction in 1878 - extension, enlargement, realignment - it remains an important part of the northside canal system. The Grand Canal was instrumental in unifying the northside system to allow for more efficient water delivery and distribution to valley water users. The necessity of the Grand Canal to the operation of the Crosscut Hydropower plant (HAER No. AZ-30) should also not be overlooked. Built at the head of the Grand, Crosscut depends on the flow of water through the Grand to generate power. Overall, the Grand Canal persists as a significant contributor to the growth and development of the Salt River Valley.

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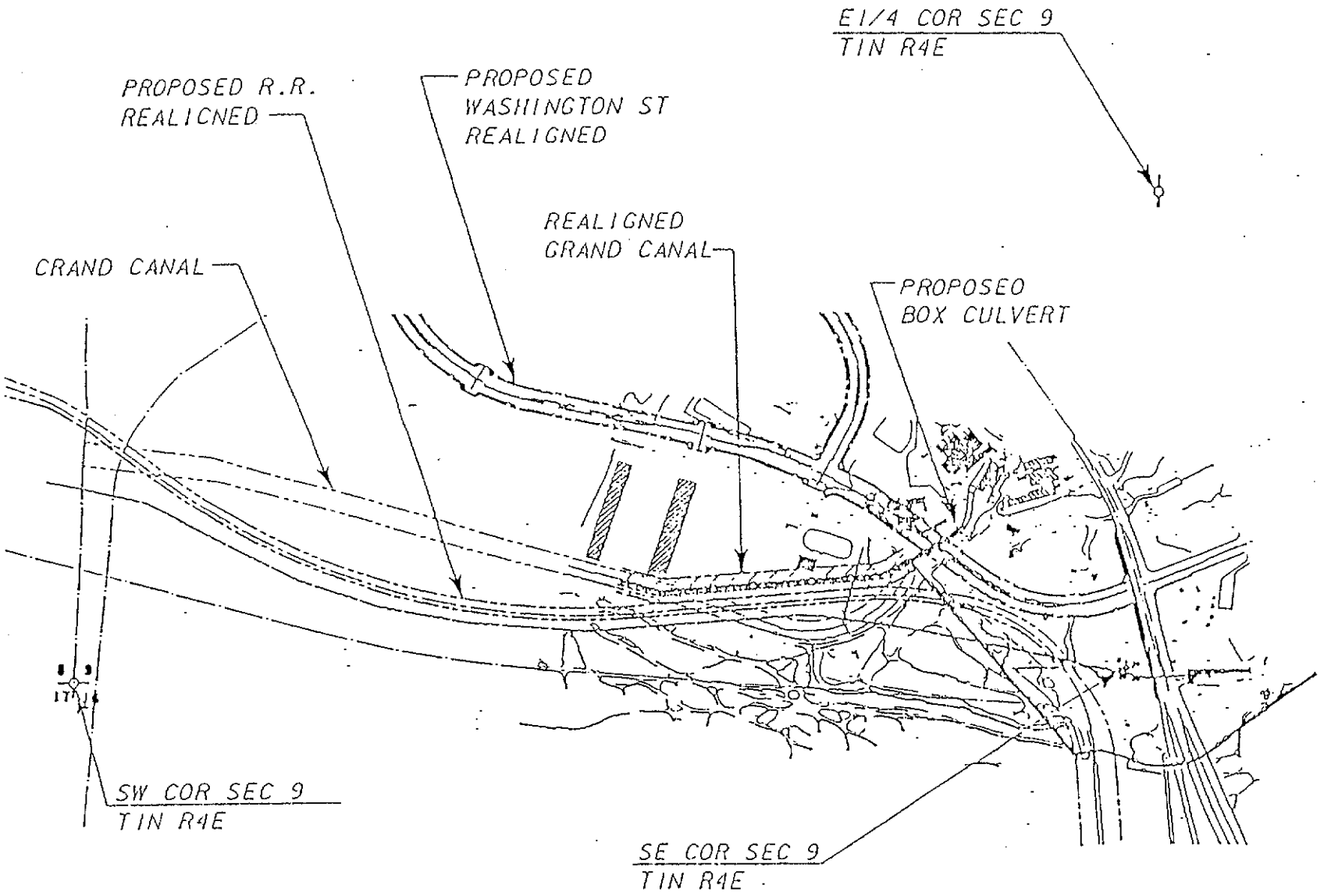
[54] Current, February 15, 1988.

MAP 3


E1/4 COR SEC 9
T1N R4E
PROPOSED R.R.
REALICNED
PROPOSED
WASHINGTON ST
REALIGNED
REALIGNED
GRAND CANAL
CRAND CANAL
PROPOSED
BOX CULVERT
SW COR SEC 9
T1N R4E
SE COR SEC 9
T1N R4E

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